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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/941,612
Filing Date: August 30, 2001
Appellant(s): AOYAGI ET AL.

MAILED

JAN 10 2005

GROUP 1700

Joe McKinney Muncy
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 11/1/2004.

(1) Real Party in Interest

Art Unit: 1765

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) *Status of Claims*

The statement of the status of the claims contained in the brief is correct.

(4) *Status of Amendments After Final*

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) *Grouping of Claims*

The rejection of claims 4-21 and 26-36 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) *Claims Appealed*

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) *Prior Art of Record*

Art Unit: 1765

5,693,139	Nishizawa et al.	12-1997
5,739,554	Edmond et al.	4-1998
4,028,720	Pankove	6-1977
5,799,027	Anayama et al.	8-1998

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 4-21, 26-28 and 33-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al (US 5,693,139) in view of Edmond et al (US 5,739,554).

Nishizawa et al discloses a method of growing doped semiconductor monolayers, note entire reference, comprising raw material gases of Gallium (Ga) and Arsenic (As), where Ga is supplied for 0.5 to 10 seconds, the chamber is evacuated, this reads on applicant's purged for a predetermined time, and As is supplied for 2 to 200 seconds and the cycle is repeated (col 7, ln 1-67; col 8, ln 1-30 and Fig 7B and Fig 11). Nishizawa et al also discloses a p-type layer is formed by introducing an impurity gases and Ga simultaneously but alternately with an As source, where the impurity gas is an Mg, Zn or Cd containing gas or Silane. Nishizawa et al also discloses a n-type layer doped with Se or S and the impurity gas is introduced cyclically with the Ga gas and As gas or the impurity gas and Ga gas are introduced simultaneously but alternately with the As gas (col 8, ln 31-60). Nishizawa et al also discloses forming pnp bipolar transistors (col 8, ln 61-67). Nishizawa et al also discloses nozzles 44, 45 and 46 for introducing gaseous compounds used for impurity doping for introducing group II, IV and VI gases (col 10, ln 50-67). Nishizawa et al also discloses different modes of doping, where the dopant is added at the

Art Unit: 1765

exhaustion of an As gas, the introduction of a Ga gas, the exhaustion of a Ga gas or at the introduction of As gas (col 11-13 and Fig 11). Nishizawa et al also discloses other III-V semiconductors are applicable to the invention (col 14, ln 5-55). Nishizawa et al also discloses introduction of a Ga source gas and a group II dopant simultaneously to form a p-type layer (col 8, ln 30-45) and the introduction of a group IV dopant after the introduction of a Ga source gas (col 15, ln 5-50). Nishizawa et al also discloses selection of the timing of doping with respect of the source gas introduction is based on the desired dopant type for the monolayer being grown (col 15, ln 45-55).

Nishizawa et al does not disclose the given time for supplying each of the impurity raw materials are close to each other.

Edmond et al teaches a gallium nitride (GaN) layer co-doped with both a Group II acceptor and Group IV donor (col 4, ln 50-67), where the group II acceptors include Zn or Mg and the Group IV donors include Si or Ge (col 6, ln 20-50), this reads on applicant's the time for supplying each of the impurity raw materials are close to each other. Edmond et al also discloses the GaN layer is formed by CVD, where Trimethylgallium (TMG), ammonia, silane and biscyclopentadienyl magnesium, $(Cp)_2Mg$ are used as reactant gases (col 7, ln 45-67 and col 8, ln 1-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishizawa et al with Edmond et al to form a co-doped GaN layer useful as an active layer (Abstract).

The combination of Nishizawa et al and Edmond et al is silent to forming impurity pairs within at least one of the crystal raw materials. The combination of Nishizawa et al and Edmond et al teach supplying similar raw materials and impurities, as applicant. Also, the combination of

Art Unit: 1765

Nishizawa et al and Edmond et al teach a similar method of supplying raw materials, purging and supplying impurities, as applicant. Therefore, the plural types of impurity raw forming impurity pairs within at least one of the crystal raw materials is inherent to the invention taught by the combination of Nishizawa et al and Edmond et al. The inherent forming of impurity pairs using co-deposition is evidenced by Pankove (US 4,028,720) and Anayama et al (US 5,799,027), below.

The combination of Nishizawa et al and Edmond et al is silent to causing a decrease in activation energy and an increase in carrier concentration. The combination of Nishizawa et al and Edmond et al inherently teach forming impurity pairs of similar raw materials and impurities, as applicant, therefore a decrease in activation energy and an increase in a carrier concentration is inherent because impurity pairs are formed. The formation of similar impurity pairs will be expected to have the same results of decreasing the activation energy and increasing carrier concentration. Furthermore, Applicant has admitted that the activation energy is decreased and the carrier concentration is increased as a result of forming impurities pair, note page 19, lines 11-17 of the reply filed on 8/25/2003, which provides evidence of the decrease in activation energy and increase in carrier concentration is inherent when impurity pairs are formed.

(11) Response to Argument

Applicant's arguments filed 11/1/2004 have been fully considered but they are not persuasive.

Art Unit: 1765

The primary issues regarding the rejection of the pending claims in view of the prior art of record are whether the prior teaches all of the limitations and whether the effects of the claimed invention would inherently occur. Appellants' invention is the supply of crystal raw materials and impurity gases by cycling raw material and impurity raw material separated by a purge gas, which is taught by Nishizawa et al, note Figure 11. Edmond et al teaches the use of a plurality of impurity gases in a co-doping process, which the Examiner maintains reads on Appellants' supplying each of the impurity gases for a given time, where the timing are close to each other, because co-doping by definition means the dopants are supplied together. Regarding the inherency argument, the Examiner has provided secondary references supporting the Examiner's position that the effects of the claimed invention, forming impurity pairs, would occur from co-doping, which Appellants have chosen to ignore because the references were not included in the heading of the rejection and only provided in the body of rejection along with column and line location of information citing the portions used by the Examiner.

Appellants' argument that the Examiner is incorrect for relying on Pankove (US 4,028,720) and Anayama et al (US 5,799,027) as evidence of inherency (pg 9) is noted but is not persuasive. Appellants allege that because the Examiner did not apply the references as part of the rejection, relying on these references as evidence of inherency is incorrect. The Examiner clearly stated in the body of the rejection, page 4 of the final rejection, that Pankove and Anayama et al were relied upon as evidence of inherency and also clearly stated on page 11 of the final rejection the exact column and line cites of Pankove and Anayama used by the Examiner. Appellants' arguments are based only on semantics because the references were not included in the heading of the rejection. Clearly, the Examiner has included the references in the

Art Unit: 1765

rejection by stating that Anayama and Pankove were relied upon as a teaching of inherency and Appellants have had the opportunity to contest the teachings of Anayama and Pankove, but Appellants have chosen to ignore their teachings because the references were not included in the heading of the rejection. Furthermore, MPEP 2112 states once the Examiner present evidence or reasoning tending to show inherency, the burden shifts to the applicant to show an unobvious difference. MPEP 2112 does not require the evidence tending to show inherency to be incorporated in the heading of the rejection and Appellants' have not met their burden showing an unobvious difference to properly rebut the inherency position taken by the Examiner.

Appellants' argument that co-doping does not indicate that the time for supplying the impurity materials are close to each other is noted but is not persuasive. Appellants allege that co-doping in general does not teach supplying each of the plural types of impurity raw materials, where the given time for supplying each of the impurity raw materials are close to each other. Firstly, Appellants require that the given time for supplying each of impurity raw material are *close* to each other. The term "close" is extremely broad and is open to many different interpretations. Appellants teach "close" timing means that the impurity is supplied at the same time, after or before the supplying of raw materials (page 3, line 22 to page 4, line 5); therefore anything reads on Appellants' "close timing". Secondly, co-doping a single layer with n-type and p-type dopants requires the dopants to be in "close timing" together because if the dopants are not in close timing then the layer would not be co-doped but rather two different layers with a single type dopant. Thirdly, co-doping by definition meets the required limitation. Merriam-Webster defines "co-" to mean with, together; therefore the n-type and p-type dopants are by definition supplied together, which reads on Appellants' "close timing" because Appellants teach

Art Unit: 1765

that “close timing” encompasses supplying the impurities at the same time. Furthermore, it is noted that Appellants use “co-doping” to cause a decrease in activation energy and to increase carrier concentration, note the last paragraph of claim 26.

Appellants’ argument that Edmond et al teaches continuous supply is noted but is not persuasive. Appellants’ allege that Edmond et al teaches forming a layer with a net conductivity, which teaches away from impurity materials being close to each other (page 10, line 20 to page 11, line 5). Appellants argument only strengthens the Examiners position that co-doping requires the supply of both types of impurities at the same time, which reads on Appellants supply of impurities in close timing, because Appellants argue the teachings of Edmond requires continuous supply of impurity materials. The continuous supply of impurities suggests that the impurities are supplied together with the raw materials. Nishizawa et al is relied upon as a teaching of separate raw material and impurity gas pulsed. Edmond is relied solely upon as a teaching of supplying a plurality of impurity gases at the same time, which reads on Appellants’ “close timing”.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Edmond et al is allowed to teach the conventional process of continuous supply of raw material and impurity raw materials without purging because this feature is taught by Nishizawa et al. Nishizawa et al teaches the alternate introduction of raw materials and impurities gases separated by a purge. Edmond et al is

Art Unit: 1765

relied upon solely as teaching that supplying two different types of impurities at the same time to form a co-doped semiconductor is known.

Appellants' argument against the inherency position taken by the Examiner regarding the features in the final paragraph of claim 26 is noted but is not persuasive. Appellants' allege that since conventional types of co-doping taught on page 2 of the specification have used co-doping without producing the claimed features; therefore the claimed features would not be inherent in view of Nishizawa and Edmond's teachings. However, this argument ignores the teachings of Nishizawa. Nishizawa teaches the pulsing a raw material AsH_3 , an impurity gas A, B, C, or D and a raw material TEG (Fig 11), as Appellant (page 11, lines 20 to page 12, line 19 of the specification). Appellant teaches the advantage of the instant invention is the pulsing of raw materials and impurity gas instead of a continuous supply method (page 11, lines 13-24 of the specification). Continuous supply co-doping differs from the Examiners position of inherency in view of the combined teachings of Nishizawa and Edmond. The Examiner maintains that pulsing raw material and impurity gases with co-doping inherently forms impurity pairs because co-doping forms impurity pairs, as evidenced by Pankove (US 4,028,720) and Anayama et al (US 5,799,027), and Appellants attribute the decrease in activation energy and increase carrier concentration from the formation of impurity pairs. The combination of pulsed deposition with co-doping is the method used by Appellants to obtain the claimed effects and the method used by Appellants is obvious in view the combined teachings of Nishizawa and Edmond. Furthermore, Appellants teach on page 21, lines 9-14 of the specification that a Mg-Si impurity pair is formed by supplying a p-type and n-type impurity raw material, which supports the Examiner's position that the presence of p-type and n-type dopant will inherently form an impurity pair.

Art Unit: 1765

In conclusion, Edmond's co-doping is relied upon by the Examiner as a teaching of supplying impurity raw because co-doping, by definition, requires the supply of a plurality of dopants to the same layer in a "close timing" to form a co-doped layer, which Appellants disagree because Edmond does not explicitly teach when the raw materials are supplied. Also, the Examiner maintains that the Appellants have not properly rebutted the inherency position taken by the Examiner because the Appellants have not addressed the teachings supporting the Examiner's position of inherency and Appellants have not shown an unobvious difference.


For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,


Matthew J Song
Examiner
Art Unit 1765

Matthew Song
January 4, 2005

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